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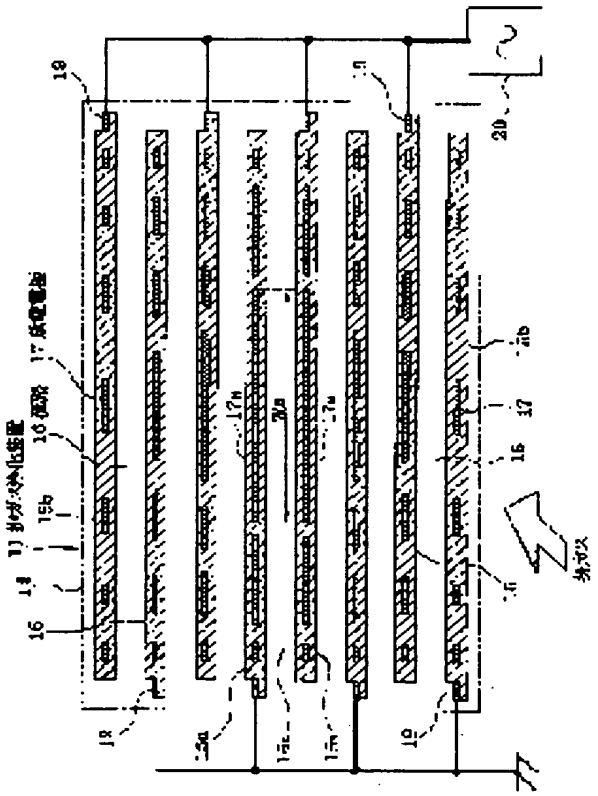
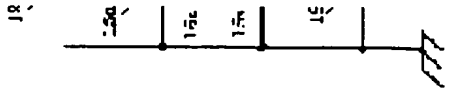
(71) Applicant : **DENSO CORP**
(72) Inventor : **ARAKAWA MIYAO**

(54) EXHAUST EMISSION CONTROL DEVICE FOR INTERNAL COMBUSTION ENGINE

(57)Abstract:
PROBLEM TO BE SOLVED: To perform efficient exhaust emission control by the generated amount of electric discharge smaller than in the past.
SOLUTION: A plurality of insulating substrates 15 are arranged in parallel in an emission control housing 14, a flow path 16 for exhaust gas is formed between each insulating substrate 15, also a plurality of electric discharge electrodes 17 are respectively embedded in each insulating substrate 15, and the exhaust gas is purified by generating a discharge in each flow path 16. For changing a discharge generated amount, according to the distribution of a flow amount of exhaust gas in the emission control housing 14, an electric discharge electrode 17a positioned in a central part of the emission control housing 14 is formed in the widest





lateral width, to obtain the largest discharge area, from here the discharge electrode 17, as it goes toward a peripheral part (lateral direction and vertical direction), is formed in small lateral width, to obtain a small electric discharge area. In this way, the distribution of the generated amount of electric discharge in the emission control housing 14 generates the largest generated amount of electric discharge in the central part of the emission control housing 14 having a large flow rate of exhaust gas, the generated amount of electric discharge, in accordance with going toward the peripheral part of a small flow rate of exhaust gas, is decreased.

* NOTICES *

CLAIMS

[Claim(s)]
[Claim 1]By passing exhaust gas of an internal-combustion engine to a channel formed among at least one pair of discharge electrodes, and generating discharge between these discharge electrodes. A diesel-particulate filter of an internal-combustion engine, wherein said discharge electrode is constituted in a diesel-particulate filter of an internal-combustion engine which purifies exhaust gas so that it may become distribution of a discharge yield according to exhaust gas flow rate distribution in a diesel-particulate filter.
[Claim 2]A diesel-particulate filter of the internal-combustion engine according to claim 1, wherein said discharge electrode is constituted so that the downstream of a discharge yield may become less than an upstream part of said channel.
[Claim 3]By passing exhaust gas of an internal-combustion engine to a channel formed among at least one pair of discharge electrodes, and generating discharge between these discharge electrodes. A diesel-particulate filter of an internal-combustion engine, wherein said discharge electrode is constituted in a diesel-particulate filter of an internal-combustion engine which purifies exhaust gas so that the downstream of a discharge yield may become less than an upstream part of said channel.
[Claim 4]A diesel-particulate filter of the internal-combustion engine according to any one of claims 1 to 3, wherein a discharge yield is adjusted by changing a discharge area of said discharge electrode.
[Claim 5]A diesel-particulate filter of the internal-combustion engine according to any one of claims 1 to 4, wherein a discharge yield is adjusted by changing an interval between said discharge electrodes.

[Translation done.]

* NOTICES *

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention]This invention relates to the diesel-particulate filter of the internal-combustion engine which promotes the cleaning reaction of exhaust gas using discharge.
[0002]
[Description of the Prior Art]In recent years, the new emission-gas-purification art which purifies exhaust gas using spark discharge energy is studied. For example, as shown in a U. S. Pat. No. 5746051 gazette (refer to drawing 9), Impressing alternating current high voltage and forming [form the purification housing 2 in the middle of the exhaust pipe 1 of an internal-combustion engine arrange two or more plate electrodes 3 in parallel with a prescribed interval in this purification housing 2,] uniform discharging space between each discharge electrode 3. There are some which purified exhaust gas by passing exhaust gas to the channel between each discharge electrode 3.
[0003]
[Problem(s) to be Solved by the Invention]Generally, since the purification housing 2 is formed more thickly [in order to form many discharge channels] than the exhaust pipe 1, the exhaust gas flow rate in the purification housing 2 has many center sections where exhaust gas goes straight on from the exhaust pipe 1, and is in the tendency whose periphery decreases. For this reason, in the diesel-particulate filter which forms uniform discharging space in the whole diesel-particulate filter like the above-mentioned well-known example. When discharge is uniformly generated between each discharge electrode 3 so that a discharging amount required to purify the exhaust gas which flows through a center section with many exhaust gas flow rates may be obtained, in a periphery with few exhaust gas flow rates, a discharge yield becomes superfluous to an exhaust gas flow rate, and there is a fault of consuming useless electric power.
[0004]This invention is made in consideration of such a situation, therefore the purpose is to provide the diesel-particulate filter of the internal-combustion engine which can purify exhaust gas efficiently with a small discharge yield, and can reduce power consumption from before.
[0005]
[Means for Solving the Problem]To achieve the above objects, a diesel-particulate filter of

an internal-combustion engine of claim 1 of this invention constitutes a discharge electrode so that it may become distribution of a discharge yield according to exhaust gas flow rate distribution. If it does in this way, when there are many exhaust gas flow rates, A discharge yield increases, and when there are few exhaust gas flow rates, Since a discharge yield decreases, even places [of an exhaust gas flow rate / few], a discharge yield cannot become superfluous to the exhaust gas flow rate, but useless power consumption can be reduced, and little power consumption can purify exhaust gas efficiently from before.
[0006]Purification follows exhaust gas, so that it goes to a downstream of a channel, and concentration of exhaust gas components which NOx etc. should purify becomes low. In consideration of this point, like claims 2 and 3, a discharge electrode may be constituted so that the downstream of a discharge yield may become less than an upstream part of a channel. If it does in this way, by a downstream which becomes low, a discharge yield does not become superfluous to an exhaust gas component amount which should be purified, but concentration of exhaust gas components which should be purified can reduce useless power consumption.
[0007]In this case, it may be made to adjust a discharge yield by changing a discharge area of a discharge electrode like claim 4. That is, since many discharge occurs to large space so that a discharge area of a discharge electrode is enlarged, a discharge yield can be easily adjusted with adjustment of a discharge area of a discharge electrode.
[0008]It may be made to adjust a discharge yield by changing an interval between discharge electrodes like claim 5. That is, since an electric field between discharge electrodes becomes strong and it becomes easy to generate discharge so that an interval between discharge electrodes is narrowed, a discharge yield can be easily adjusted also with adjustment of an interval between discharge electrodes.
[0009]
[Embodiment of the Invention][Embodiment (1)] The embodiment (1) of this invention is hereafter described based on drawing 1 thru/or drawing 5. As shown in drawing 4, the diesel-particulate filter 11 is formed in the middle of the exhaust pipe 13 of the engine 12 which is an internal-combustion engine. The purification housing 14 of this diesel-particulate filter 11 is formed more thickly than the exhaust pipe 13, in order to form many channels 16.
[0010]As shown in drawing 1, in the purification housing 14, two or more insulating substrates 15 are arranged in parallel with a prescribed interval, and the flat channel 16 through which exhaust gas passes between each insulating substrate 15 is formed. Each insulating substrate 15 is formed with the existing heat-resistant insulators (for example, ceramics, such as alumina, glass, etc.) of the dielectric which discharge tends to produce. In each insulating substrate 15, two or more discharge electrodes 17 formed of a printed conductor or plate conducting, respectively are embedded. It was connected with this by the connected conductors 18 (refer to drawing 2 and drawing 3) formed in one, and the connecting terminal section 19 formed in the end part of these connected conductors 18 has exposed each discharge electrode 17 to the exterior of the insulating substrate 15. The surface (internal surface of the channel 16) of each insulating substrate 15 is coated with the catalyst (not shown) which promotes the cleaning reaction of exhaust gas.
[0011]Each insulating substrate 15 is arranged for right-and-left reverse by turns, and the connecting terminal section 19 is located in a right-and-left opposite hand by turns. The connecting terminal section 19 located in the one side (left-hand side of drawing 1) of the

exhaust emission control device 11 is connected to the ground side, and the connecting terminal section 19 located in the other side (right-hand side of drawing 1) is connected to the output terminal of the high-voltage transformer assembly 20 which generates the alternating current high voltage of high frequency, for example. Thereby, at the time of operation of the high-voltage transformer assembly 20, the alternating current high voltage of high frequency is impressed between the discharge electrodes 17 which counter across each channel 16, and discharge occurs in each channel 16.

[0012]Next, the composition of the discharge electrode 17 is explained using drawing 1 thru/or drawing 3. The cross-sectional view of the insulating substrate 15b in which drawing 2 (a) is located in the highest rung (bottom) of the purification housing 14 here, The cross-sectional view of the insulating substrate 15a in which drawing 2 (b) is located in drawing of longitudinal section of the insulating substrate 15b, and drawing 3 (a) is located in the middle of the purification housing 14, and drawing 3 (b) are drawings of longitudinal section of the insulating substrate 15a.

[0013]Two or more discharge electrodes 17 of the insulating substrate 15 of each stage are formed in band-like [from which breadth differs], and are arranged in parallel along the exhaust gas flow direction. And it is formed so that the breadth Wa of the discharge electrode 17a located in the center section of the insulating substrate 15a of the middle may become the largest and a discharge area may become the largest, and it is formed so that it goes to a periphery (a longitudinal direction and a sliding direction) from there, and the breadth of the discharge electrode 17 may become narrow and a discharge area may become small. Thereby, the discharge yield of distribution of the discharge yield in the purification housing 14 increases most in the center section (center section of the channel 16a of the middle) of the purification housing 14, and it is constituted so that it goes to a periphery (a longitudinal direction and a sliding direction) from a center section, and a discharge yield may decrease.

[0014]In the diesel-particulate filter 11 constituted as mentioned above, if the alternating current high voltage of high frequency is impressed between the discharge electrodes 17 which counter across each channel 16, discharge plasma will occur in each channel 16. Thereby, the exhaust gas which flows through the inside of each channel 16 is efficiently purified by operation of both discharge plasma and the catalyst of the internal surface of the channel 16.

[0015]As mentioned above, since the purification housing 14 is formed more thickly than the exhaust pipe 13, the exhaust gas flow rate in the purification housing 14 has many center sections where exhaust gas goes straight on from the exhaust pipe 13, and is in the tendency whose periphery decreases. Many discharge comes to occur to large space, so that the discharge area of the discharge electrode 17 becomes large.

[0016]In consideration of these characteristics, in this embodiment (1). In order to make the discharge area of the discharge electrode 17 small so that the discharge area of the discharge electrode 17a of the center section of the purification housing 14 is enlarged most and it goes to a periphery from there, A discharge yield increases most in the center section in which an exhaust gas flow rate increases most, and a discharge yield decreases, so that it goes to the periphery whose exhaust gas flow rate decreases. Since distribution of the discharge yield in the purification housing 14 turns into proper distribution according to exhaust gas flow rate distribution by this, A discharge yield cannot become superfluous to

the exhaust gas flow rate, but a periphery with few exhaust gas flow rates can also reduce useless power consumption, and can purify exhaust gas efficiently with little power consumption from before.

[0017]Although it was made to change the discharge yield of each position in the purification housing 14 in the both directions of a longitudinal direction and a sliding direction in this embodiment (1), The discharge yield of each position in the purification housing 14 may be changed only in a sliding direction, without making it change in a longitudinal direction, or it may be made to make it change only in a longitudinal direction, without making it change in a sliding direction.

[0018][Embodiment (2)] in the embodiment (2) of this invention shown in drawing 5. He connects the catalytic converters 21, such as a three way component catalyst and an oxidation catalyst, with the downstream of the same discharge system diesel-particulate filter 11 of composition as the above-mentioned embodiment (1), and is trying for the catalytic converter 21 to purify further the exhaust gas purified with the discharge system diesel-particulate filter 11. If it does in this way, the rate of emission gas purification can be further improved with the combination of the discharge system diesel-particulate filter 11 and the catalytic converter 21.

[0019][Embodiment (3)] Next, the embodiment (3) of this invention is described using drawing 6. Here, drawing 6 is a cross-sectional view of the insulating substrate 22 located in the middle of the purification housing 14.

[0020]At said embodiment (1), although breadth of each discharge electrode 17 of the insulating substrate 15 of each stage was made into constant width from the upstream part to the downstream, as shown in drawing 6, by this embodiment (3), the breadth of each discharge electrode 23 of the insulating substrate 22 of each stage is formed from the upstream part so that it may become narrow toward a downstream. Thereby, in the downstream, the discharge area of each discharge electrode 23 becomes small rather than an upstream part, and the discharge yield of the downstream of each channel 16 becomes less than an upstream part. The discharge electrode 23a located in the both-the-right-and-left-ends part of each insulating substrate 22 may be formed only in the upstream part of the channel 16. Other composition is the same as said embodiment (1). Therefore, the discharge area (breadth) of the discharge electrode 23 is small formed, so that this embodiment (3) also enlarges the discharge area (breadth) of the discharge electrode 23 of the center section of the purification housing 14 and goes to a periphery (a longitudinal direction and a sliding direction) from there. Thereby, distribution of the discharge yield in the purification housing 14 is also distribution according to exhaust gas flow rate distribution.

[0021]Since the concentration of the exhaust gas components (henceforth "an unpurified ingredient") which purification should follow the exhaust gas which flows through each channel 16, so that it goes to the downstream of the channel 16, and NOx etc. should purify becomes low, If it constitutes like this embodiment (3) so that the discharge yield of the downstream may become less than the upstream part of each channel 16, by the downstream which becomes low, a discharge yield does not become superfluous to an unpurified component amount, but unpurified constituent concentration can reduce useless power consumption.

[0022]And in this embodiment (3), since the discharge yield of each position in the purification housing 14 was changed also according to exhaust gas flow rate distribution,

Distribution of the discharge yield in the purification housing 14 becomes the effect and **** to which a discharge yield is changed in an exhaust gas flow direction with a still more proper thing, and useless power consumption can be reduced further. However, it may be made for this invention to change the discharge yield of each position in the purification housing 14 only in an exhaust gas flow direction, without making it change by exhaust gas flow rate distribution.

[0023][Embodiment (4)] Although the discharge yield was adjusted by changing the discharge area (breadth) of the discharge electrodes 17 and 23 at each above-mentioned embodiment (1) - (3), In the embodiment (4) of this invention shown in drawing 7 and drawing 8. The electric field between the discharge electrodes 25 becomes strong, and its attention is paid to the characteristic discharge becomes easy to generate, so that the interval between the discharge electrodes 25 is narrowed, He is trying to adjust a discharge yield by changing the interval (interval between the discharge electrodes 25 of up-and-down both sides of each channel 16) between each insulating substrate 24 arranged in parallel in the purification housing 14. Therefore, in this embodiment (4), the discharge area of the discharge electrode 25 which is altogether formed in the quadrangular shape of the same size, and counters the upper and lower sides of each channel 16 of the discharge electrode 25 laid underground in each insulating substrate 24 is the same.

[0024]In this embodiment (4), in order to change the discharge yield of each position in the purification housing 14 according to exhaust gas flow rate distribution, The interval (interval between the discharge electrodes 25) between the insulating substrates 24 is made large, and it is made to lessen a discharge yield, so that the interval (interval between the discharge electrodes 25) between the insulating substrates 24a of two sheets located in the middle of the purification housing 14 is made the narrowest, a discharge yield is made [most] and it goes to a sliding direction from there. Even if it does in this way, the discharge yield of each position in the purification housing 14 can be changed according to exhaust gas flow rate distribution, and useless power consumption can be reduced.

[0025]In this embodiment (4), although the discharge electrode 25 of each insulating substrate 24 was altogether formed in the quadrangular shape of the same size, the breadth of the discharge electrode 25 of each insulating substrate 24 may be formed as well as said embodiment (3) so that the downstream may become narrow rather than an upstream part. Thereby, the same effect as said embodiment (3) can be acquired.

[0026]Or art of this embodiment (4) may be carried out combining the art of said embodiment (1). That is, two or more discharge electrodes are laid underground, both the interval between the discharge electrodes of each stage and a discharge area (breadth) are changed according to exhaust gas flow rate distribution, and it may be made to adjust a discharge yield according to exhaust gas flow rate distribution in the insulating substrate of each stage.

[0027]In addition, in the range which does not deviate from a gist, it changes suitably that it is good also as composition which does not coat a catalyst on the surface of an insulating substrate, and the channel of exhaust gas may be formed in honeycomb shape etc., and this invention can carry out it. [it]

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1]The vertical section front view of the diesel-particulate filter of an embodiment (1)
[Drawing 2]As for (a), the cross-sectional view of the insulating substrate located in the highest rung (bottom) of the diesel-particulate filter of an embodiment (1) and (b) are drawings of longitudinal section of the insulating substrate.
[Drawing 3]The cross-sectional view of the insulating substrate located in the middle of the diesel-particulate filter of an embodiment (1)
[Drawing 4]The outline lineblock diagram of the whole exhaust gas purifying system of an embodiment (1)
[Drawing 5]The outline lineblock diagram of the whole exhaust gas purifying system of an embodiment (2)
[Drawing 6]The cross-sectional view of the insulating substrate located in the middle of the diesel-particulate filter of an embodiment (3)
[Drawing 7]The vertical section front view of the diesel-particulate filter of an embodiment (4)
[Drawing 8]The cross-sectional view of the insulating substrate of an embodiment (4)
[Drawing 9]The vertical section side view of the conventional diesel-particulate filter
[Description of Notations]
11 -- A diesel-particulate filter, 12 -- An engine (internal-combustion engine), 13 -- Exhaust pipe, 14 [-- A discharge electrode, 20 / -- A high-voltage transformer assembly, 21 / -- A catalytic converter, 22 / -- An insulating substrate, 23 23a / -- A discharge electrode, 24 / -- An insulating substrate, 25 / -- Discharge electrode.] -- Purification housing, 15, 15a -- An insulating substrate, 16, 16a -- A channel, 17, 17a

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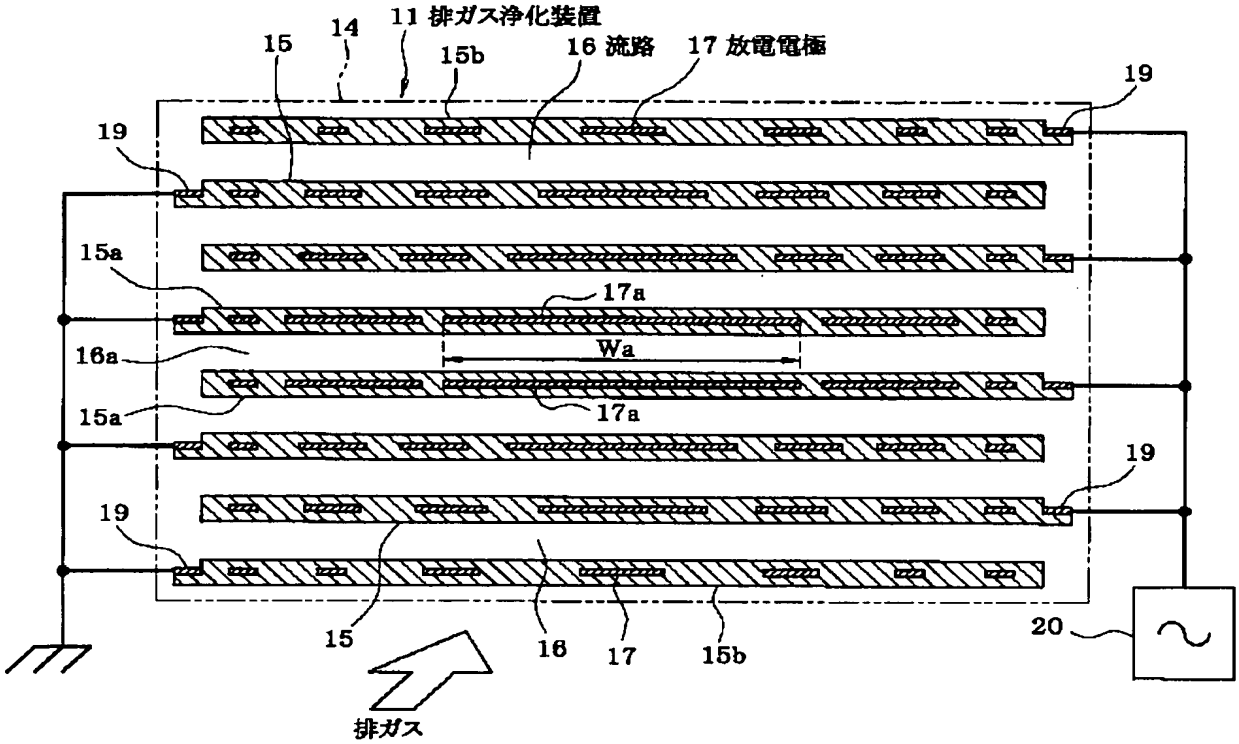
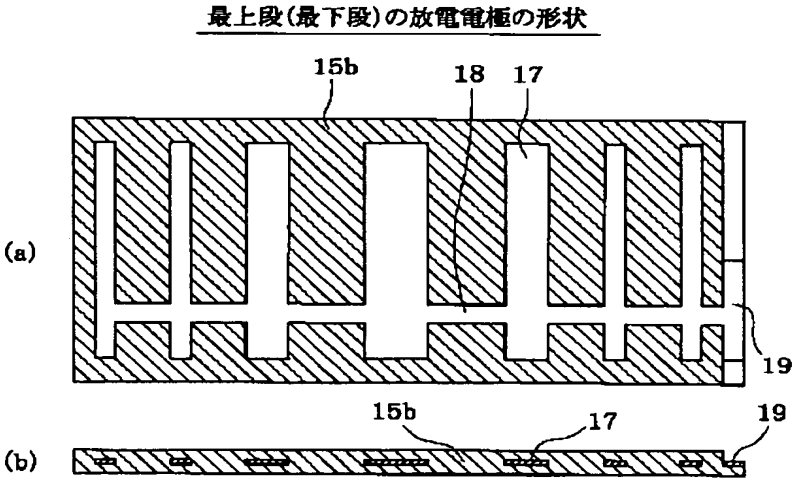
DRAWINGS

[Drawing 1]

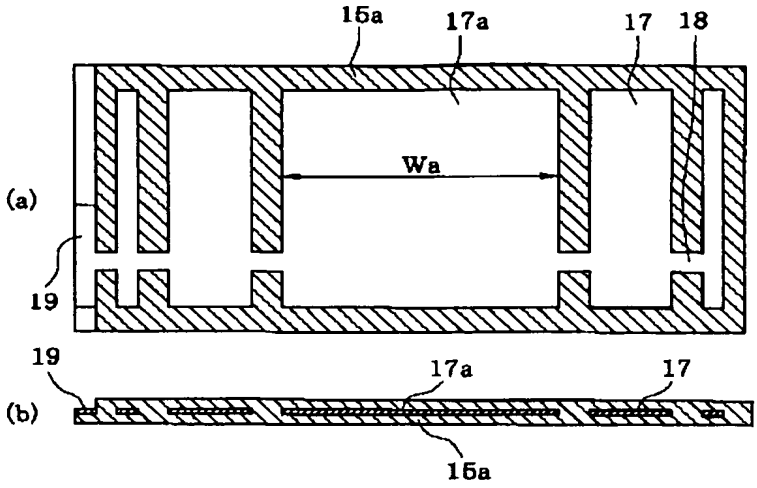


[Drawing 2]

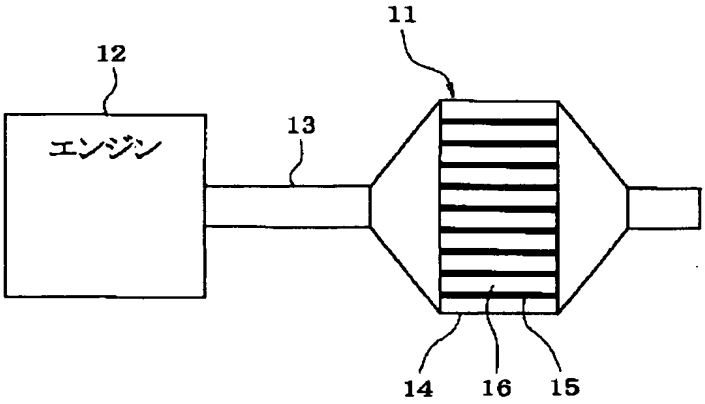


[Drawing 3]

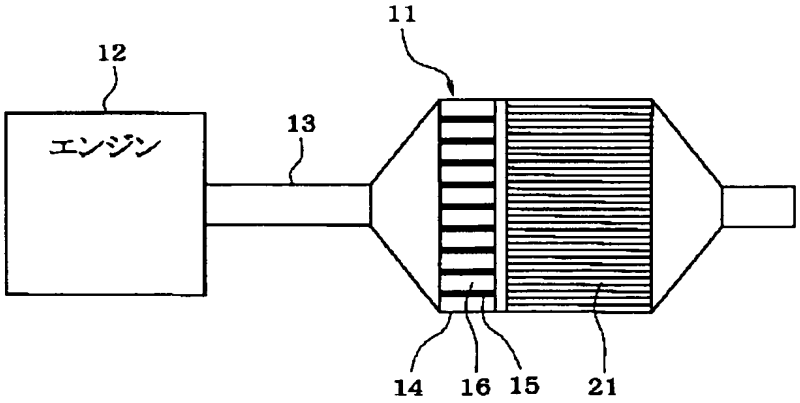
中段の放電電極の形状



[Drawing 4]

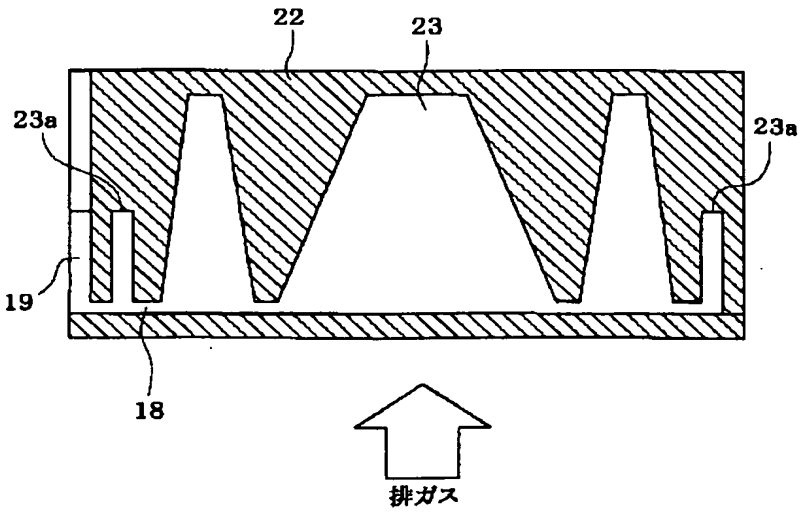


[Drawing 5]

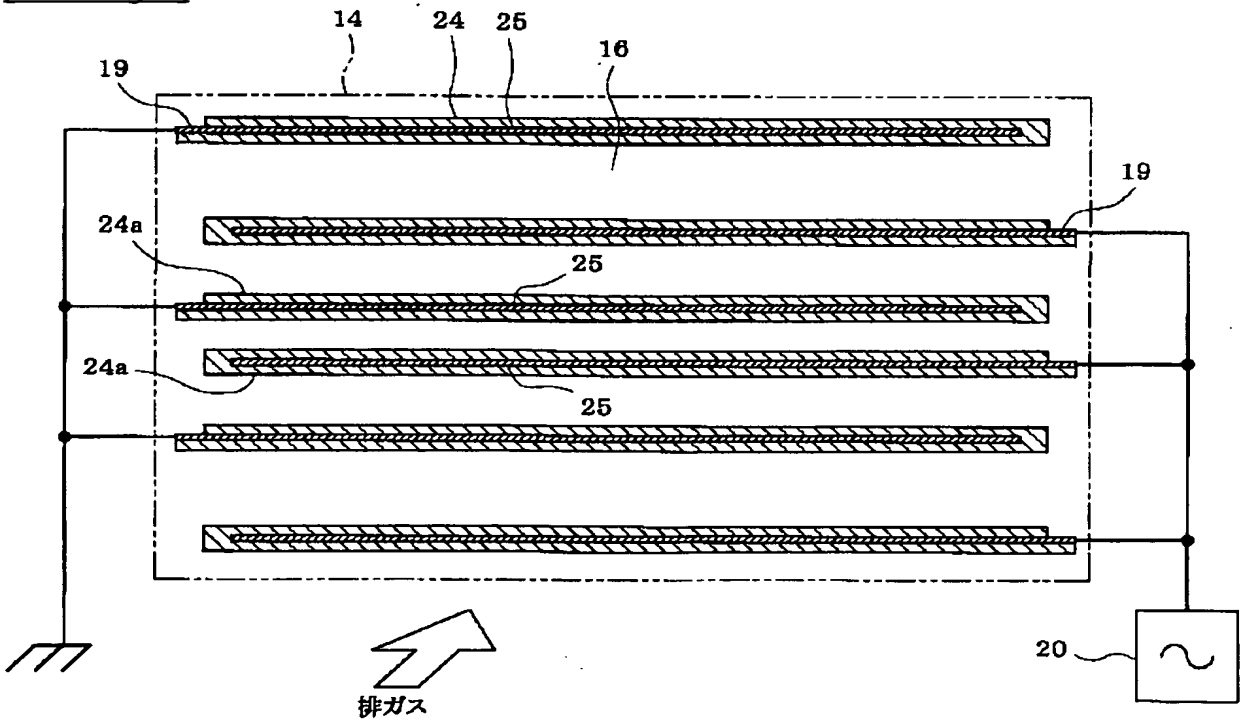


[Drawing 6]

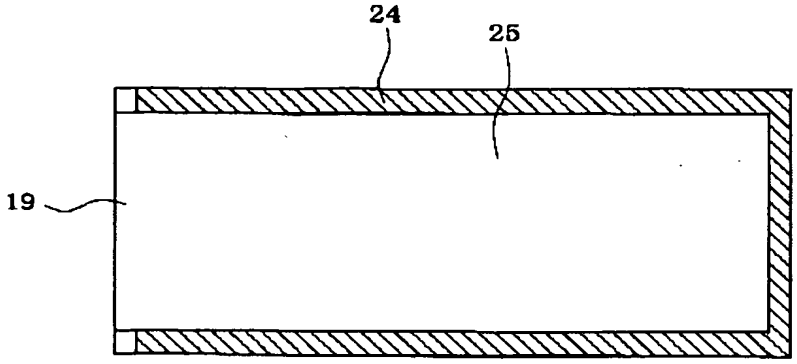
中段の放電電極の形状



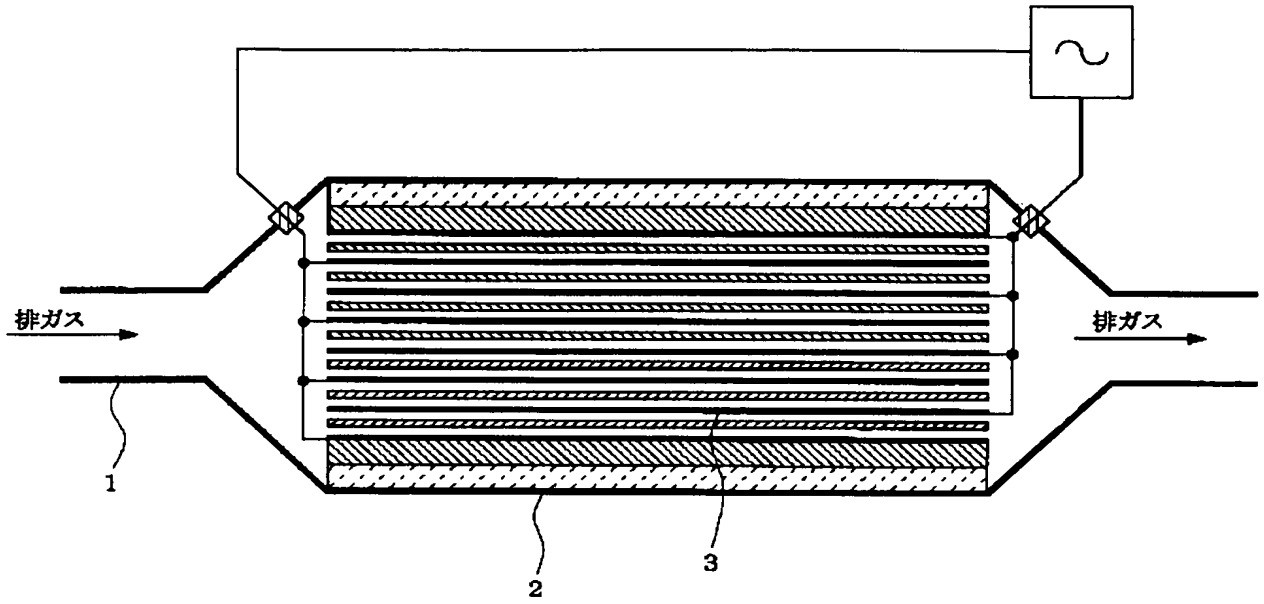
[Drawing 7]



[Drawing 8]



[Drawing 9]



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53/34	ＺＡＢ	53/34	ＺＡＢＺ	４Ｄ０４８
53/72			１２０Ｄ	
53/56			１２９Ｃ	

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(71)出願人　000004260
株式会社デンソー
愛知県刈谷市昭和町１丁目１番地
(72)発明者　荒川　宮男
愛知県刈谷市昭和町１丁目１番地　株式会社デンソー内
(74)代理人　100098420
弁理士　加古　宗男

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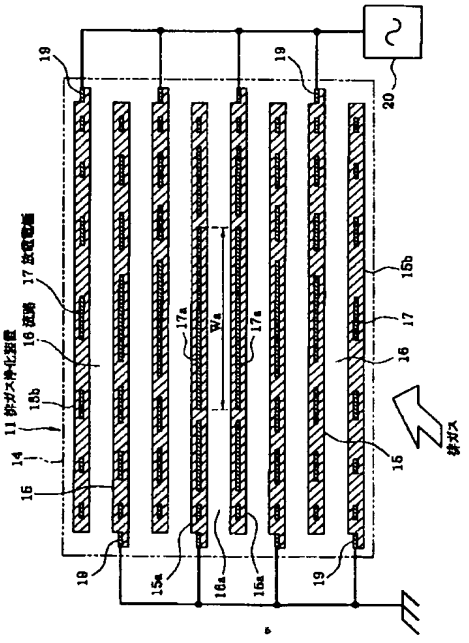
(54)【発明の名称】　内燃機関の排ガス浄化装置

(57)【要約】
【課題】　従来より少ない放電発生量で排ガスを効率良く浄化する。
【解決手段】　浄化ハウジング１４内に複数の絶縁基板１５を平行に配置し、各絶縁基板１５間に排ガスの流路１６を形成すると共に、各絶縁基板１５内にそれぞれ複数の放電電極１７を埋め込み、各流路１６内で放電を発生させて排ガスを浄化する。浄化ハウジング１４内の排ガス流量分布に応じて放電発生量を変化させるために、浄化ハウジング１４の中央部に位置する放電電極１７ａの横幅を最も広くして放電面積を最も大きくし、そこから周辺部（左右方向及び上下方向）に向かうほど放電電極１７の横幅を狭くして放電面積を小さくする。これにより、浄化ハウジング１４内の放電発生量の分布は、排ガス流量の多い浄化ハウジング１４の中央部で放電発生量が最も多くなり、排ガス流量の少ない周辺部に向かうほど放電発生量が少なくなる。



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【特許請求の範囲】

【請求項１】　内燃機関の排ガスを少なくとも１対の放電電極間に形成された流路に流し、該放電電極間で放電を発生させることで、排ガスを浄化する内燃機関の排ガス浄化装置において、

前記放電電極は、排ガス浄化装置内の排ガス流量分布に応じた放電発生量の分布となるように構成されていることを特徴とする内燃機関の排ガス浄化装置。

【請求項２】　前記放電電極は、前記流路の上流部よりも下流部の方が放電発生量が少なくなるように構成されていることを特徴とする請求項１に記載の内燃機関の排ガス浄化装置。

【請求項３】　内燃機関の排ガスを少なくとも１対の放電電極間に形成された流路に流し、該放電電極間で放電を発生させることで、排ガスを浄化する内燃機関の排ガス浄化装置において、

前記放電電極は、前記流路の上流部よりも下流部の方が放電発生量が少なくなるように構成されていることを特徴とする内燃機関の排ガス浄化装置。

【請求項４】　前記放電電極の放電面積を変えることで放電発生量が調整されていることを特徴とする請求項１乃至３のいずれかに記載の内燃機関の排ガス浄化装置。

【請求項５】　前記放電電極間の間隔を変えることで放電発生量が調整されていることを特徴とする請求項１乃至４のいずれかに記載の内燃機関の排ガス浄化装置。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、放電を利用して排ガスの浄化反応を促進させる内燃機関の排ガス浄化装置に関するものである。

【０００２】

【従来の技術】近年、放電エネルギを利用して排ガスを浄化する新たな排ガス浄化技術が研究されている。例えば、米国特許第５７４６０５１号公報（図９参照）に示すように、内燃機関の排気管１の途中に浄化ハウジング２を設け、この浄化ハウジング２内に複数の平板電極３を所定間隔で平行に配置し、各放電電極３間に交流高電圧を印加して一様な放電場を形成しながら、排ガスを各放電電極３間の流路に流すことで、排ガスを浄化するようにしたものがある。

【０００３】

【発明が解決しようとする課題】一般に、浄化ハウジング２は、多くの放電流路を形成するために、排気管１よりも太く形成されているため、浄化ハウジング２内の排ガス流量は、排気管１から排ガスが直進する中央部が多く、周辺部が少なくなる傾向にある。このため、上記公知例のように排ガス浄化装置全体に一様な放電場を形成する排ガス浄化装置では、排ガス流量の多い中央部を流れる排ガスを浄化するのに必要な放電量が得られるように各放電電極３間に一様に放電を発生させると、排ガス流量の少ない周辺部では、排ガス流量に対して放電発生量が過剰となってしまい、無駄な電力を消費してしまうという欠点がある。

2

【０００４】本発明はこのような事情を考慮してなされたものであり、従ってその目的は、従来より少ない放電発生量で排ガスを効率良く浄化することができ、消費電力を低減することができる内燃機関の排ガス浄化装置を提供することにある。

【０００５】

【課題を解決するための手段】上記目的を達成するために、本発明の請求項１の内燃機関の排ガス浄化装置は、排ガス流量分布に応じた放電発生量の分布となるように放電電極を構成したものである。このようにすれば、排ガス流量が多いところでは、放電発生量が多くなり、排ガス流量が少ないところでは、放電発生量が少なくなるので、排ガス流量の少ないところでも、その排ガス流量に対して放電発生量が過剰とならず、無駄な電力消費を低減することができ、従来より少ない消費電力で排ガスを効率良く浄化することができる。

【０００６】また、排ガスは、流路の下流部に向かうほど浄化が進み、ＮＯｘ等の浄化すべき排ガス成分の濃度が低くなる。この点を考慮して、請求項２，３のように、放電電極を、流路の上流部よりも下流部の方が放電発生量が少なくなるように構成しても良い。このようにすれば、浄化すべき排ガス成分の濃度が低くなる下流部で、浄化すべき排ガス成分量に対して放電発生量が過剰とならず、無駄な電力消費を低減することができる。

【０００７】この場合、請求項４のように、放電電極の放電面積を変えることで放電発生量を調整するようにしても良い。つまり、放電電極の放電面積を大きくするほど、広い空間に多くの放電が発生するため、放電電極の放電面積の調整によって、簡単に放電発生量を調整することができる。

【０００８】また、請求項５のように、放電電極間の間隔を変えることで放電発生量を調整するようにしても良い。つまり、放電電極間の間隔を狭くするほど、放電電極間の電界が強くなって放電が発生しやすくなるため、放電電極間の間隔の調整によっても、簡単に放電発生量を調整することができる。

【０００９】

【発明の実施の形態】［実施形態（１）］以下、本発明の実施形態（１）を図１乃至図５に基づいて説明する。図４に示すように、排ガス浄化装置１１は、内燃機関であるエンジン１２の排気管１３の途中に設けられている。この排ガス浄化装置１１の浄化ハウジング１４は、多くの流路１６を形成するために、排気管１３よりも太く形成されている。

【００１０】図１に示すように、浄化ハウジング１４内には、複数の絶縁基板１５が所定間隔で平行に配置され、各絶縁基板１５間に排ガスが通過する偏平な流路１

６が形成されている。各絶縁基板１５は、放電の生じやすい誘電性のある耐熱性絶縁体（例えばアルミナ等のセラミック、ガラス等）で形成されている。各絶縁基板１５内には、それぞれ印刷導体又は導電板によって形成された複数の放電電極１７が埋め込まれている。各放電電極１７は、これと一体に形成された接続導体１８（図２及び図３参照）によって接続され、この接続導体１８の一端部に形成された接続端子部１９が絶縁基板１５の外部に露出している。また、各絶縁基板１５の表面（流路１６の内壁面）には、排ガスの浄化反応を促進させる触媒（図示せず）がコーティングされている。

【００１１】各絶縁基板１５は、交互に左右逆向きに配置され、接続端子部１９が交互に左右反対側に位置している。排気浄化装置１１の一方側（図１の左側）に位置する接続端子部１９はグランド側に接続され、他方側（図１の右側）に位置する接続端子部１９は、例えば高周波の交流高電圧を発生する高電圧発生装置２０の出力端子に接続されている。これにより、高電圧発生装置２０の動作時には、各流路１６を挟んで対向する放電電極１７間に高周波の交流高電圧が印加され、各流路１６内で放電が発生する。

【００１２】次に、放電電極１７の構成を図１乃至図３を用いて説明する。ここで、図２（ａ）は浄化ハウジング１４の最上段（最下段）に位置する絶縁基板１５ｂの横断面図、図２（ｂ）は同絶縁基板１５ｂの縦断面図、図３（ａ）は浄化ハウジング１４の中段に位置する絶縁基板１５ａの横断面図、図３（ｂ）は同絶縁基板１５ａの縦断面図である。

【００１３】各段の絶縁基板１５の複数の放電電極１７は、横幅の異なる帯状に形成され、排ガス流れ方向に沿って平行に配列されている。そして、中段の絶縁基板１５ａの中央部に位置する放電電極１７ａの横幅Ｗａが最も広くなって放電面積が最も大きくなるように形成され、そこから周辺部（左右方向及び上下方向）に向かうほど放電電極１７の横幅が狭くなって放電面積が小さくなるように形成されている。これにより、浄化ハウジング１４内の放電発生量の分布は、浄化ハウジング１４の中央部（中段の流路１６ａの中央部）で放電発生量が最も多くなり、中央部から周辺部（左右方向及び上下方向）に向かうほど放電発生量が少なくなるように構成されている。

【００１４】以上のように構成した排ガス浄化装置１１では、各流路１６を挟んで対向する放電電極１７間に高周波の交流高電圧が印加されると、各流路１６内で放電プラズマが発生する。これにより、放電プラズマと流路１６の内壁面の触媒との両方の作用によって、各流路１６内を流れる排ガスが効率良く浄化される。

【００１５】前述したように、浄化ハウジング１４は排気管１３よりも太く形成されているため、浄化ハウジング１４内の排ガス流量は、排気管１３から排ガスが直進する中央部が多く、周辺部が少なくなる傾向にある。また、放電電極１７の放電面積が大きくなるほど、広い空間に多くの放電が発生するようになる。

【００１６】これらの特性を考慮して、本実施形態（１）では、浄化ハウジング１４の中央部の放電電極１７ａの放電面積を最も大きくし、そこから周辺部に向かうほど放電電極１７の放電面積を小さくするようにしているため、排ガス流量が最も多くなる中央部で放電発生量が最も多くなり、排ガス流量が少なくなる周辺部に向かうほど放電発生量が少なくなる。これにより、浄化ハウジング１４内の放電発生量の分布が排ガス流量分布に応じた適正な分布となるため、排ガス流量の少ない周辺部でも、その排ガス流量に対して放電発生量が過剰とならず、無駄な電力消費を低減することができ、従来より少ない消費電力で排ガスを効率良く浄化することができる。

【００１７】尚、本実施形態（１）では、浄化ハウジング１４内の各位置の放電発生量を左右方向と上下方向の両方向で変化させるようにしたが、浄化ハウジング１４内の各位置の放電発生量を左右方向で変化させずに上下方向のみで変化させたり、或は、上下方向で変化させずに左右方向のみで変化させるようにしても良い。

【００１８】［実施形態（２）］図５に示す本発明の実施形態（２）では、上記実施形態（１）と同じ構成の放電式の排ガス浄化装置１１の下流側に、三元触媒、酸化触媒等の触媒コンバータ２１を連結し、放電式の排ガス浄化装置１１で浄化した排ガスを更に触媒コンバータ２１で浄化するようにしている。このようにすれば、放電式の排ガス浄化装置１１と触媒コンバータ２１との組み合わせによって排ガス浄化率を更に向上することができる。

【００１９】［実施形態（３）］次に、図６を用いて本発明の実施形態（３）を説明する。ここで、図６は、浄化ハウジング１４の中段に位置する絶縁基板２２の横断面図である。

【００２０】前記実施形態（１）では、各段の絶縁基板１５の各放電電極１７の横幅を上流部から下流部まで一定幅としたが、本実施形態（３）では、図６に示すように、各段の絶縁基板２２の各放電電極２３の横幅を上流部から下流部へ向かって狭くなるように形成している。これにより、各放電電極２３の放電面積が上流部よりも下流部の方が小さくなり、各流路１６の放電発生量が上流部よりも下流部の方が少なくなる。尚、各絶縁基板２２の左右両端部に位置する放電電極２３ａは、流路１６の上流部のみに形成しても良い。その他の構成は、前記実施形態（１）と同じである。従って、本実施形態（３）でも、浄化ハウジング１４の中央部の放電電極２３の放電面積（横幅）を大きくし、そこから周辺部（左右方向及び上下方向）に向かうほど放電電極２３の放電面積（横幅）を小さく形成している。これにより、浄化

ハウジング１４内の放電発生量の分布が排ガス流量分布に応じた分布にもなっている。

【００２１】各流路１６を流れる排ガスは、流路１６の下流部に向かうほど浄化が進み、ＮＯｘ等の浄化すべき排ガス成分（以下「未浄化成分」という）の濃度が低くなるため、本実施形態（３）のように、各流路１６の上流部よりも下流部の方が放電発生量が少なくなるように構成すれば、未浄化成分濃度が低くなる下流部で、未浄化成分量に対して放電発生量が過剰とならず、無駄な電力消費を低減することができる。

【００２２】しかも、本実施形態（３）では、浄化ハウジング１４内の各位置の放電発生量を排ガス流量分布によっても変化させたので、排ガス流れ方向で放電発生量を変化させる効果と相待って、浄化ハウジング１４内の放電発生量の分布が更に適正なものとなり、無駄な電力消費を更に低減することができる。しかしながら、本発明は、浄化ハウジング１４内の各位置の放電発生量を排ガス流量分布で変化させずに排ガス流れ方向のみで変化させるようにしても良い。

【００２３】［実施形態（４）］上記各実施形態（１）～（３）では、放電電極１７，２３の放電面積（横幅）を変えることで放電発生量を調整するようにしたが、図７及び図８に示す本発明の実施形態（４）では、放電電極２５間の間隔を狭くするほど、放電電極２５間の電界が強くなって放電が発生しやすくなる特性に着目し、浄化ハウジング１４内に平行に配置された各絶縁基板２４間の間隔（各流路１６の上下両面の放電電極２５間の間隔）を変えることで放電発生量を調整するようにしている。従って、本実施形態（４）では、各絶縁基板２４内に埋設された放電電極２５は、全て同じ大きさの四角形状に形成され、各流路１６の上下に対向する放電電極２５の放電面積は同一となっている。

【００２４】本実施形態（４）では、浄化ハウジング１４内の各位置の放電発生量を排ガス流量分布に応じて変化させるために、浄化ハウジング１４の中段に位置する２枚の絶縁基板２４ａ間の間隔（放電電極２５間の間隔）を最も狭くして放電発生量を最も多くし、そこから上下方向に向かうほど絶縁基板２４間の間隔（放電電極２５間の間隔）を広くして放電発生量を少なくするようにしている。このようにしても、浄化ハウジング１４内の各位置の放電発生量を排ガス流量分布に応じて変化させることができ、無駄な電力消費を低減することができる。

【００２５】尚、本実施形態（４）では、各絶縁基板２４の放電電極２５を全て同じ大きさの四角形状に形成したが、前記実施形態（３）と同じく、各絶縁基板２４の放電電極２５の横幅を上流部よりも下流部の方が狭くなるように形成しても良い。これにより、前記実施形態（３）と同じ効果を得ることができる。

【００２６】或は、本実施形態（４）の技術を前記実施形態（１）の技術と組み合わせて実施しても良い。つまり、各段の絶縁基板内に複数の放電電極を埋設し、排ガス流量分布に応じて各段の放電電極間の間隔と放電面積（横幅）の両方を変えて放電発生量を排ガス流量分布に応じて調整するようにしても良い。

【００２７】その他、本発明は、絶縁基板の表面に触媒をコーティングしない構成としても良く、また、排ガスの流路をハニカム状に形成しても良い等、要旨を逸脱しない範囲で適宜変更して実施できる。

【図面の簡単な説明】

【図１】実施形態（１）の排ガス浄化装置の縦断正面図

【図２】（ａ）は実施形態（１）の排ガス浄化装置の最上段（最下段）に位置する絶縁基板の横断面図、（ｂ）は同絶縁基板の縦断面図

【図３】実施形態（１）の排ガス浄化装置の中段に位置する絶縁基板の横断面図

【図４】実施形態（１）の排ガス浄化システム全体の概略構成図

【図５】実施形態（２）の排ガス浄化システム全体の概略構成図

【図６】実施形態（３）の排ガス浄化装置の中段に位置する絶縁基板の横断面図

【図７】実施形態（４）の排ガス浄化装置の縦断正面図

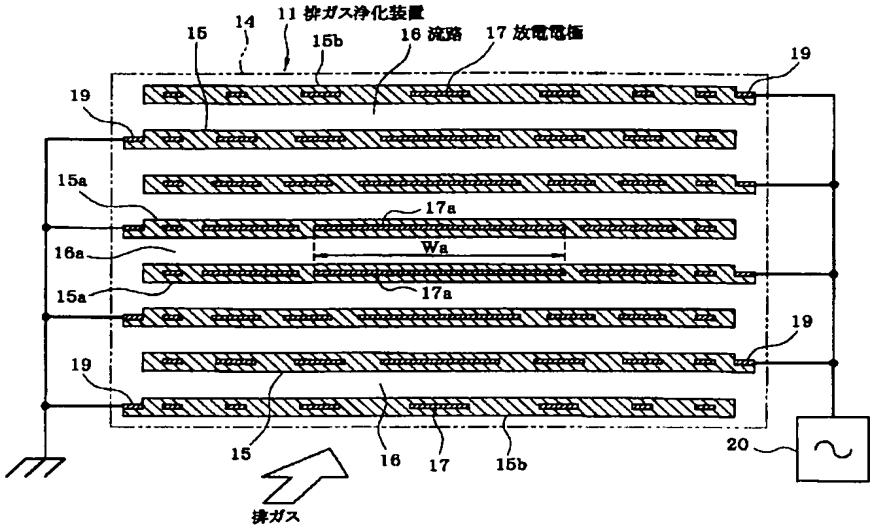
【図８】実施形態（４）の絶縁基板の横断面図

【図９】従来の排ガス浄化装置の縦断側面図

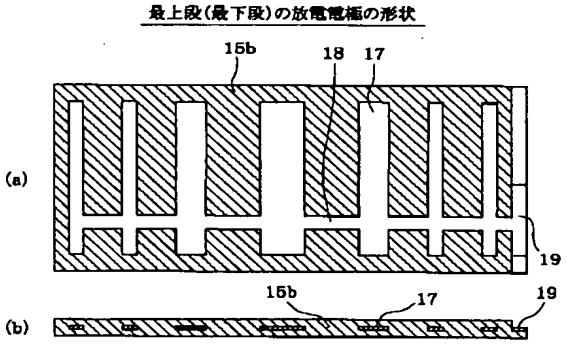
【符号の説明】

１１…排ガス浄化装置、１２…エンジン（内燃機関）、１３…排気管、１４…浄化ハウジング、１５，１５ａ…絶縁基板、１６，１６ａ…流路、１７，１７ａ…放電電極、２０…高電圧発生装置、２１…触媒コンバータ、２２…絶縁基板、２３，２３ａ…放電電極、２４…絶縁基板、２５…放電電極。

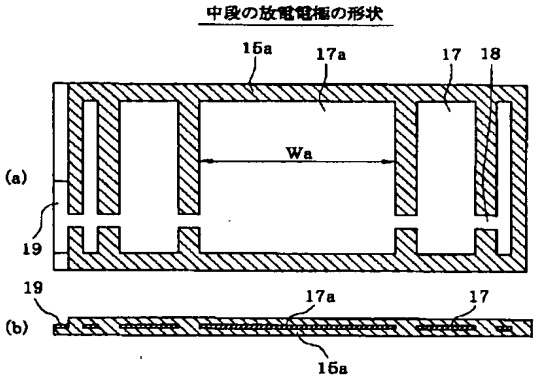
【図１】


11 排ガス浄化装置
14
15
15b
16 流路
17 放電電極
19
15a
17a
16a
Wa
20
排ガス

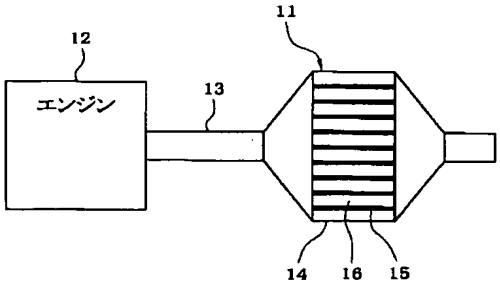
【図２】


最上段(最下段)の放電電極の形状
15b
18
17
(a)
19
(b)

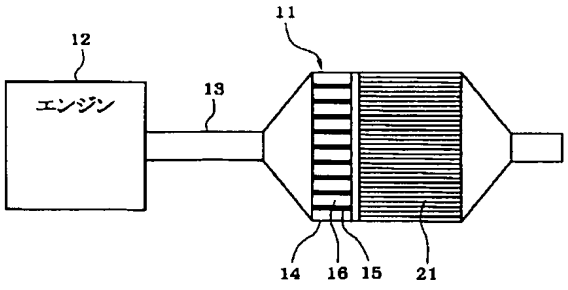
【図３】


中段の放電電極の形状
15a
17a
17
18
Wa
(a)
19
(b)
16a

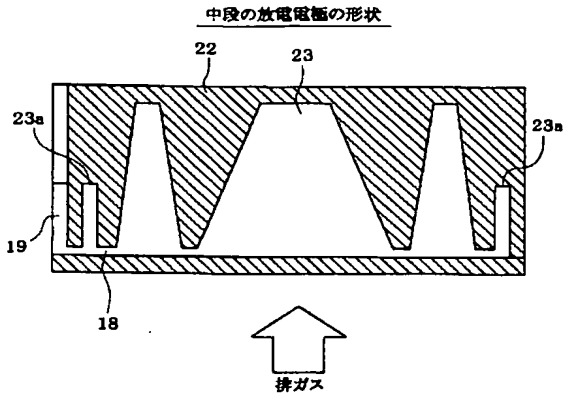
【図４】


11
12
エンジン
13
14
16
15

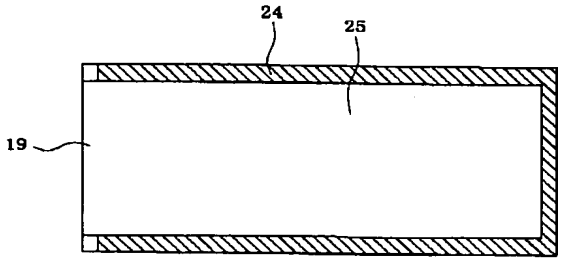
【図５】


11
12
エンジン
13
14
16
15
21

【図６】


中段の放電電極の形状
22
23
23a
23a
19
18
排ガス

【図８】


24
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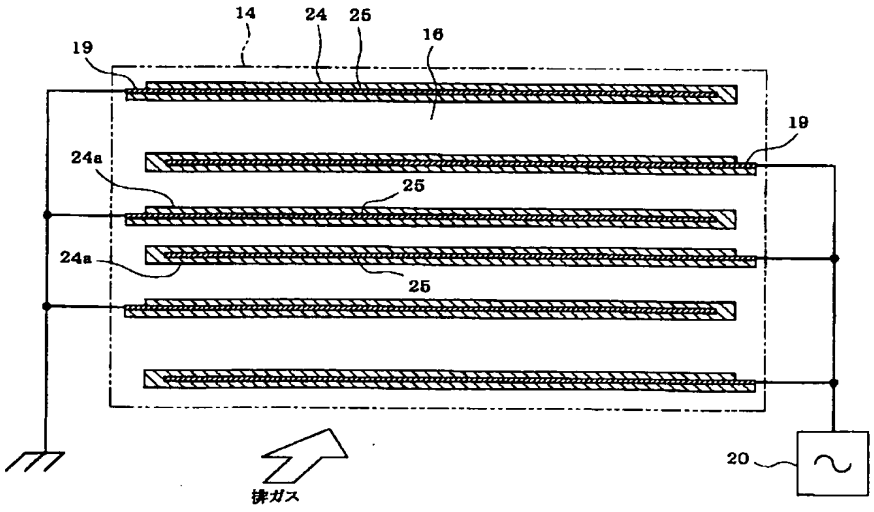
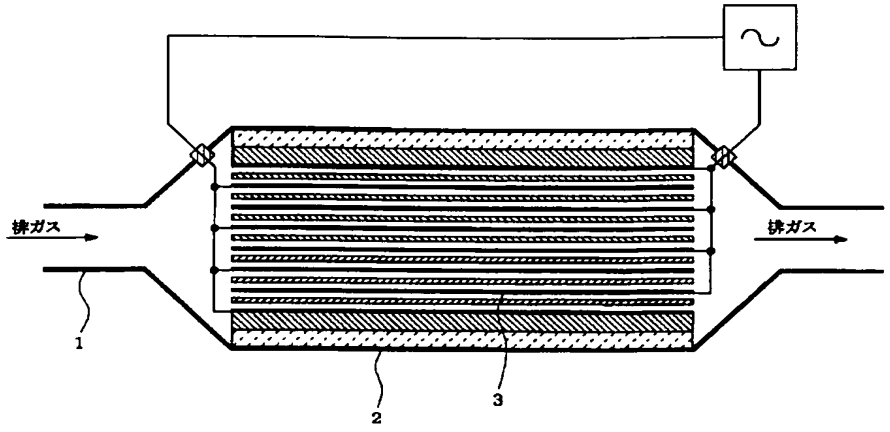
19

【図７】


14
24
25
16
19
19
24a
25
24a
25
排ガス
20

【図９】



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	53/62			53/36	B
	53/86				

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HA07
4D002 AA08 AA12 AA40 AC10 BA05
BA07 CA07 DA70 GB01 HA01
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AB03 AB05 BB03 CA01 CC33
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